SUMMARY OF
2001 SEATTLE ENERGY CODE PROPOSAL

(1 August 2001)

DCLU has now forwarded recommendations for the **2001 Seattle Energy Code** to the Seattle City Council. The proposed effective date is the end of the year, 31 December 2001.

This document is a companion to the ordinance that contains additional Seattle amendments to the 2000 Washington State Energy Code. Within this document are

- An Overview with frequently asked questions (page 2),
- Summary of Key Changes Proposed (page 8),
- Costs and Energy Savings for Key Issues (page 9), and
- Discussion of Proposed Amendments (page 13).

These recommendations have been developed through a six-month public review process. Since January, DCLU has conducted weekly public review meetings (22 in total), as well as having review meetings with and providing briefings to professional organizations (Seattle Chapter AIA, Puget Sound ASHRAE, BOMA of Seattle and King County, Electric League of the Pacific Northwest), and finally getting recommendations from the DCLU Construction Codes Advisory Board (CCAB) to develop and refine this package of Energy Code amendments. City Councilmembers Heidi Wills and Richard Conlin participated in a Public Forum held on 12 July 2001 that provided an additional opportunity for discussion and public comment. DCLU thanks all the participants for their efforts and contributions to develop the most workable proposal.

In most cases, (1) there was consensus from the public review meetings and CCAB discussions on the proposed code language, and (2) DCLU and Seattle City Light staff concur with that consensus. Preliminary consultant analysis suggests that the improvement from current practice in Seattle to achieve the goal in Resolution 30280 would be less than 10%.

The Energy and Environmental Policy Committee of the Seattle City Council will hold three public hearings: (1) Wednesday, 15 August 2001, 5:30 pm, (2) Thursday, 16 August 2001, 9:30 am, and (3) Thursday, 6 September 2001, 9:30 am. All hearings will take place in the Council chambers in the Seattle Municipal Building, 600 4th Avenue, Seattle. For further information, see http://www.cityofseattle.net/council.

For questions, please contact John Hogan at (206) 386-9145 or john.hogan@ci.seattle.wa.us or Michael Aoki-Kramer at (206) 684-7932 or michael.aoki-kramer@ci.seattle.wa.us.

OVERVIEW

This section provides a context for the 2001 Seattle Energy Code proposal. The questions addressed are:

1. Does the City of Seattle have a comprehensive response to the energy situation that includes new generation and incentive programs?
2. How has the current energy situation affected Seattle in the last year?
3. What is the State of Washington doing and what are other jurisdictions doing in terms of their Energy Codes to respond to this situation?
4. What does Resolution 30280 require? What is the baseline and how does this compare with other work being done? What is the likely impact on current practice?
5. Do the changes in the Seattle Energy Code affect energy credits in the LEED green building program?
6. Why are changes being proposed for nonresidential buildings but not for residential buildings?
7. What has been done to provide for public participation in the development of these recommendations?
8. Do the DCLU recommendations differ substantially from the CCAB recommendations or those from the review group meetings?
9. Does the Energy Code contain any performance approaches or is there only a prescriptive compliance option?
10. What about existing buildings? Why are changes being proposed for the way that the Energy Code treats mechanical systems in existing buildings?
11. When would these Energy Code revisions take effect?
12. Will there be any other Energy Code changes?

Frequently Asked Questions

1. Does the City of Seattle have a comprehensive response to the energy situation that includes new generation and incentive programs?

Yes, during the summer and fall of 2000 the Mayor and City Council reviewed Seattle City Light's energy needs over the next ten-year period and adopted a Strategic Resource Plan. The Proposed Energy Code revisions are but one part of a much larger strategy and acknowledge the fact that more than 60% of the cost effective conservation investments in the commercial sector are in new buildings and/or major retrofits.

Key elements of that Strategic Resource Plan include:

- Meet base load growth consistent with the City Council's Earth Day Resolution. This directs Seattle City Light to meet load growth with cost-effective energy efficiency and renewable resources to the greatest extent possible, and mitigate any greenhouse gas emission that are a result of that load growth. More specifically, Seattle City Light will double the current conservation goal over the next ten year

period to acquire roughly 100 aMW of cost effective conservation, review and pilot new approaches to load management, and strive to acquire 100 aMW of renewable resources over the ten year period.
- Sign a new contract with the Bonneville Power Administration effective October 1, 2001 that increases the quantity of power purchased from 195 aMW at present to roughly 500 aMW.
-Contract for 100 aMW of the output of a combustion turbine as a hedge against adverse weather and water condition and extraordinary load growth and to meet peak demands.

2. How has the current energy situation affected Seattle in the last year?

In terms of electricity, Seattle City Light has incurred significantly increased costs to meet its purchased power needs over the past year. To cover these power cost increases the City Council has already implemented 3 power rate surcharges totaling more than 40% of customer rates. Another will go into effect on October 1st when the increased prices associated with the new Bonneville Power Administration contract hit the utility's rate base. These power cost surcharges have been structured to allow the utility's ratepayers to re-pay the exorbitant power purchase costs of the past year over a multi-year period. However, they are not the reason the City is pursuing changes in its Energy Code at this point in time. That was part of the longer term Strategic Resource Plan approved by the City before the current energy crisis hit.

In addition, natural gas prices have also increased substantially within the last year.

3. What is the State of Washington doing and what are other jurisdictions doing in terms of their Energy Codes to respond to this situation?

In May 2001, Governor Locke sent a letter to the Washington State Building Code Council (WSBCC) requesting further improvements to the Washington State Energy Code. In response, the WSBCC will be adopting further revisions to the Washington State Energy Code this year.

In April 2001, Tacoma adopted revisions to the nonresidential portions of the Energy Code. These provisions affect both new construction AND the OPERATION of existing buildings (such as exterior lighting). Tacoma considered the energy situation so pressing that they adopted the revisions as an emergency ordinance and it took effect two days later.

Seattle has received inquiries from other jurisdictions about our work. Seattle City officials are sharing our work on the Energy Code with other cities.

4. What does Resolution 30280 require? What is the baseline and how does this compare with other work being done? What is the likely impact on current practice?

In February 2001, the Seattle City Council passed by a vote of 9-0 Resolution 30280 directing DCLU and Seattle City Light to bring forward a package of Energy Code amendments that would achieve a 20% improvement in energy efficiency for nonresidential buildings over that achieved through ASHRAE/IESNA Standard 90.1-

1999. ASHRAE is the American Society of Heating, Refrigerating, and Air-Conditioning Engineers. IESNA is the Illuminating Engineering Society of North America. (There are no proposed changes for Group R occupancy.) This resolution was summarized in the Daily Journal of Commerce in their 13 February 2001 issue.

Resolution 30280 specifies ASHRAE/IESNA Standard 90.1 as the baseline (NOT the current Seattle Energy Code or current practice). While Standard 90.1 was published in 1999, most of the requirements were actually developed in the early- or mid-1990's. ASHRAE and IESNA have a committee that is working on revisions to Standard 90.1. The ASHRAE/IESNA Standard 90.1 Committee has adopted a goal to improve the energy efficiency of the 2004 version of Standard 90.1 by 20% compared to the 1999 version. In addition, Seattle is currently requiring that new City buildings achieve a 20% improvement over Standard 90.1 as part of their compliance with a Silver Rating in the LEED Green Building program.

While certainly a step forward, the change is not as significant as might first appear. Both the 2000 Washington State Energy Code and the 2000 Seattle Energy Code achieve greater energy efficiency than Standard 90.1. Indeed, preliminary consultant analysis indicates that improvement over Standard 90.1 called for in Resolution 30280 is likely to be less than a 10% change and might only entail a 6-8% improvement over current practice in Seattle.

5. Do the changes in the Seattle Energy Code affect energy credits in the LEED green building program?

No, the LEED energy credit uses ASHRAE/IESNA Standard 90.1 as the baseline for points.

6. Why are changes being proposed for nonresidential buildings but not for residential buildings?

Seattle is interested in the efficiency of residential buildings, but State law precludes amendments to the residential (Group R occupancy) portions of the Washington State Energy Code.

For nonresidential occupancies, however, the Washington State Energy Code is a minimum. The nonresidential provisions of the Washington State Energy Code have generally been written to address smaller, simpler commercial buildings that are typical in many areas throughout the State. Seattle has more complex buildings, but also more sophisticated designers and more knowledgeable plan review and inspection staff. Consequently, there is both the potential for energy-efficiency improvements and the capability to achieve them.

7. What has been done to provide for public participation in the development of these recommendations?

Seattle has an ongoing process for public participation in the development and revision of its codes. The Seattle Building Code, Section 105, provides for the establishment of a Construction Codes Advisory Board (CCAB) whose members are appointed by the Mayor and subject to confirmation by the Seattle City Council. CCAB examines proposals and makes recommendations for Seattle's technical codes including the Seattle Energy Code.

DCLU first briefed the Construction Codes Advisory Board (CCAB) in late 2000 about the upcoming Seattle Energy Code update process. This briefing included a

presentation from Seattle City Light staff about the current energy situation.

Seattle DCLU published a first draft of Seattle amendments to the 2000 Washington State Energy Code in January 2001. The availability of the draft was announced in a mailing to DCLU's Energy Code mailing list and to the Seattle Energy Code e-mail list. DCLU also provided a summary of key changes adopted for the Washington State Energy Code.

The Second Draft was published in April 2001, e-mailed to the Seattle Energy Code e-mail list, and a notice of availability mailed to DCLU's Energy Code mailing list.

Since the release of the first draft in January 2001, DCLU has been conducting a series of weekly meetings to review draft proposals. To date, 22 meetings have been held. Notices of the meetings, agendas, supplemental information for the meetings, and notes of the meetings have been posted on the Seattle Energy Code website at **www.ci.seattle.wa.us/dclu/energy**.

In addition, DCLU provided briefings to the Electric League of the Pacific Northwest Code Committee on 17 January 2001 and 18 April 2001, to the full Electric League of the Pacific Northwest on 1 May 2001, to the Seattle Chapter AIA Environment/Energy Committee on 8 February 2001 and 14 June 2001, to the Puget Sound ASHRAE TEGA Committee on 8 February 2001, 20 March 2001, and 21 May 2001, and to BOMA of Seattle and King County on 19 June 2001.

DCLU staff also participated in a series of informational meetings and roundtable discussion for architects, developers, and building owners. The first was hosted by Turner Construction and Holaday-Parks, Inc. and took place on 13 February 2001, a second was hosted by Lease Crutcher Lewis and Holaday-Parks, Inc. and took place on 5 March 2001, and a third was hosted by Mulvanny/G2 and Holaday-Parks, Inc. and took place on 6 March 2001.

DCLU staff provided a general briefing for the DCLU Construction Codes Advisory Board (CCAB) on 17 May 2001 on the recommendations from the weekly review meetings. CCAB discussed proposals and made recommendations on the lighting sections at their meeting on 7 June 2001, on the administrative sections and some of the building envelope sections on 18 June 2001, the remainder of the building envelope sections on 21 June 2001, and mechanical sections on 2 July 2001.

Please note that these recommendations have evolved significantly through the 22 review group meetings and discussions with professional organizations.

8. Do the DCLU recommendations differ substantially from the CCAB recommendations or those from the review group meetings?

In most cases, (1) there was consensus from the public review meetings and CCAB discussions on the proposed code language, and (2) DCLU and Seattle City Light staff concur with that consensus.

The DCLU proposal for Energy Code revisions contains two differences from the CCAB recommendations:

- one related to electronically-commutated motors (both CCAB and DCLU have recommended adopting a requirement for these motors, and both CCAB and DCLU have an exemption that allows an alternate system with a lower supply air temperature, however DCLU recommends that the exemption for the alternate have a sunset of June 2002);
- a second which involves DCLU recommending no change to the categorization of variable air volume systems linked with higher wall insulation, whereas CCAB had

also recommended an additional second linked pair (in this case, DCLU has recommended the least stringent of CCAB's two linked pairs).

Please see the detailed discussion of costs and energy savings for key issues that follows.

9. Does the Energy Code contain any performance approaches or is there only a prescriptive compliance option?

The Energy Code has more performance alternates than the Building, Mechanical, or other codes.

(1) Within the "prescriptive" approach, the proposed 2001 Energy Code amendments include performance credits that save designers the trouble of doing calculations and save review time. These pre-calculated/prescriptive credits include:
- allowing the use of glass Solar Heat Gain Coefficient (SHGC) in lieu of shading coefficient (this amounts to a 14% credit for products without NFRC ratings);
- credit for window overhangs and setbacks through a simple table of adjustment factors;
- allowing north-facing glazing to have an SHGC that is 0.10 higher than other orientations (for buildings with a glazing area that is 30-40% of the wall, this allowance means that the prescriptive requirements for north-glazing are actually less stringent than the current Energy Code); and
- pre-calculated options to reduce slab edge insulation and to taper roof insulation.

(2) In terms of tradeoffs with the building envelope, the Energy Code contains two options:
- (2a) the Target UA and Target SHGC procedures; and
- (2b) the ENVSTD software (given the proposed changes in the building envelope criteria, the current version of ENVSTD would need to be revised; DCLU has had discussions with the holder of the copyright for the software and they are prepared to make the changes once given the go-ahead; DCLU, with City Light funding, will arrange for that to happen once the code changes have been adopted).

(3) The Energy Code Reference Standard 29 (RS-29) provides yet another option - an allowance to do overall building tradeoffs between different building components (building envelope, mechanical, and lighting). When using this option, the Energy Code requires that the same systems be used in both the standard design (the baseline) and the proposed design. This is because the Energy Code assumes that there are many reasons other than energy for selecting building elements. For example, metal framing or masonry might be selected as the wall type (in lieu of wood) due to needs for fire-resistance. Consequently, once the designer has made those decisions, that becomes the baseline for tradeoffs. There is no penalty for choosing a less-efficient system type, but there also is no credit for a more efficient system type. Thus, a designer can not claim a metal frame wall as the baseline and get credit by "switching" to a wood frame wall. This same philosophy applies to mechanical systems. This prevents the use of an artificially low base case that would not reflect current practice. However, it also limits credits for systems that are substantially better than current practice. For truly innovative mechanical systems, where proposed design system cannot be modified to comply with standard requirements, RS-29 does allow the use of a prototype system.

10. What about existing buildings? Why are changes being proposed for the way that the Energy Code treats mechanical systems in existing buildings?

Existing buildings are significant factor in Seattle. Currently, the Energy Code has more detailed specifications for how to deal with common remodeling situations for the building envelope and lighting. For mechanical systems, there is only one sentence.

Comments during the Public Forum indicated some confusion about the proposals for existing buildings. There are no proposed modifications to the way that the Energy Code currently addresses alterations to the building envelope.

For mechanical systems, earlier draft proposals addressed the mechanical section more comprehensively. In response to discussions, DCLU has narrowed the scope of proposed revisions to economizer operation (cooling with outside air in lieu of mechanical refrigeration). This is the most important mechanical system issue in Seattle's mild climate.

DCLU has worked with the Building Owners and Managers Association (BOMA) and modified proposals so as to incorporate recommendations from BOMA.

The language now proposes compliance on either a (1) permit-by-permit basis or (2) through a long-term plan. The long-term plan approach is a new idea that is being offered. The language also provides exemptions for areas with low ceilings and where compliance is impractical.

11. When would these Energy Code revisions take effect?

There are competing interests in establishing an implementation date for these revisions. Seattle citizens and Seattle City Light would benefit from the ordinance taking effect as soon as possible so that Seattle City Light would not need to buy as much power and citizens and ratepayers' money wouldn't be lost to outside the region without providing any benefit to the local economy. On the other hand, designers and developers have some projects already in process.

The recommended effective date is the end of the year, 31 December 2001.

12. Will there be any other Energy Code changes?

There is the possibility of additional Energy Code changes both in Seattle and at the State level.

For Seattle, DCLU is recommending that there be further study of the minimum efficiencies for heating and cooling equipment. In the course of the review meetings, manufacturers representatives and others indicated that higher efficiency equipment was available. However, this was not the best year for comparison as manufacturers have been revising their product lines to meet revisions to national standards. That process should be mostly completed by November and new product directories ought to be available after the first of the year. Consequently, DCLU recommends revisiting this topic early next year.

SUMMARY OF KEY CHANGES PROPOSED FOR THE 2001 SEATTLE ENERGY CODE

A summary of key changes follows below. This summary does not list all the changes. The proposed revisions apply to nonresidential occupancies. (There are no proposed changes for Group R occupancy.) A section-by-section listing with text follows the discussion of key issues.

Building Envelope:

- Prescriptive glazing options revised to be based on glazing with low-e coatings and better solar control (Table 13-1). *Provides consistency with Standard 90.1 & addendum aj.*
- Overhead glazing U-factors revised to match actual products (Table 13-1), default U-factors for overhead glazing revised as companion change (Table 10-6).
- Allowance to use SHGC for center-of-glass (1312.2), prescriptive credits for overhangs and north-oriented glazing (1323.3), expanded table of default U-factors for masonry walls with metal studs (Table 10-5B). *Greater flexibility, ease of compliance.*
- Increased wall insulation for "other" space heat (Table 13-1).
- Increased insulation for semi-heated spaces (1310.2) and masonry walls (Table 13-1).

Mechanical Systems:

- Efficiencies for heating and cooling equipment revised (1411.1 and Tables 14-1A to M).
- More use of economizer, lower thresholds, clearer calculations for water economizer (1433).
- Higher motor efficiencies (1437 and Table 14-4).
- Requirement for electronically-commutated motors in series mixing boxes (1437).
- Maximum damper leakage established (1412.4.1).
- Duct sealing and commissioning requirements clarified (1414.1 and 1416).
- Single pass systems eliminated for water conservation purposes (1411.1).

Lighting and Power:

- Lighting power allowance revised to 1.0 W/sf for offices (but no change for small offices and medical offices), and to 1.2 W/sf for schools (Table 15-1). *Revise to reflect current practice.*
- Prescriptive option requires dimming ballasts (1521). *Companion change to Table 15-1.*
- Automatic shut-off controls required for all buildings, not only offices (1513.6). *Provides consistency with IESNA Standard 90.1. Primary energy savings are evenings and weekends.*
- Small offices, meeting and conference rooms, and school classrooms to have occupancy sensors (1513.6). *Additional energy savings during the daytime.*
- Daylighted zones to have automatic controls (1513.3). *Either stepped controls (on-off lamp-by-lamp) or continuous dimming controls are allowed.*
- Change of use to require compliance with lighting power allowance in Table 15-1.
- Certain internal building transformers to comply with NEMA TP-1-1996.

COSTS AND ENERGY SAVINGS FOR KEY ISSUES

KEY ISSUE #1:
SECTION 1437 MOTOR EFFICIENCY

Issue: Should there be a June 30, 2002 sunset on the lower-temperature supply systems exemption from the requirement that terminal units have electronically-commutated motors (ECM) or equivalent?

Background: In a typical nonresidential building, the fans run continuously to provide ventilation. Fan energy is as large or larger than the heating and cooling energy (based upon modeling and metering). Fan powered mixing boxes are used in most nonresidential buildings in Seattle. They incorporate a small motor that helps circulate the air. This motor is typically only 40-50% efficient (and can be as low as 15-20% efficiency when not operating at peak load) and has a primitive speed control that is also inefficient. Because of the number of boxes in a building, the total fan power in these little motors typically represents one-quarter of the total installed fan power. However, because these small motors run continuously while the central fan modulates on a VFD (variable frequency drive), and because they are very inefficient, they consume half of the energy used for fans in the typical building. Electronically-commutated motors provide significant energy savings.

If the Seattle Energy Code were to require that projects have electronically-commutated motors, then there would be greater energy savings compared to ASHRAE/IESNA Standard 90.1.

Discussion: Here are pros and cons for the DCLU recommendation and an estimate of energy savings and costs.

Pro: Allows designers to use a common system. Provides constant air movement which some view as improved air quality. Series boxes, which run continuously, help provide masking noise to hide unwanted noise between adjacent rooms. Electronically-commutated motors are an option offered by all the major mixing box manufacturers. This option would guarantee increased energy savings. Consultant estimate is that allowing the exemption reduces the real energy savings of this measure by over 80% since many buildings already are medium temperature systems, and because a medium temperature system saves one-third of the energy of the efficient fan option.

Con: CCAB supported the exemption so as to provide flexibility, an allowance to use an alternate system. Concern was expressed about a limited number of motor manufacturers. (However, while GE is the most well know manufacturer, FASCO has an equivalent motor, and Emerson is releasing what they are calling an ECM. As for international suppliers, EBM is believed to have a similar type of motor.)

Cost estimate: Consultant estimate of cost is $150-$230/mixing box. At one box per 1,000-2,000 square feet, the cost is roughly $0.15/square foot of building.

Energy savings estimate: Consultant estimate of site energy savings is 510-1,500 kWh per box per year ($36 to $105 at $0.07/kWh). The Carrier Company in their publication “ECM Motors in Series Flow Fan Powered Terminals and Unit Ventilators” provides a savings range of 861-1,215 kWh per box per year ($60 to $85 at $0.07/kWh).

Simple Payback: 3-4 years.

KEY ISSUE #2:
TABLE 13-1 BUILDING ENVELOPE REQUIREMENTS – WALL INSULATION FOR THE "OTHER" SPACE HEAT TYPE

Issue: Should the wall insulation requirements for metal framed walls be revised to require R-13 insulation plus a layer of R-3.8 continuous insulation?

Background: After windows, walls are responsible for the greatest heat flow through nonresidential buildings. The current Energy Code has a prescriptive requirement of R-11 minimum wall insulation for projects that are in the "other" space heat category. (R-19 minimum wall insulation in wood framing is the prescriptive requirement for the electric resistance space heat category.) However, the metal framing that is commonly used in nonresidential construction provides a serious thermal bridge that bypasses the insulation. Consequently, as shown in Table 10-5A in the Energy Code, an R-11 batt installed between metal studs only provides the equivalent of R-5.5 insulation – a 50% reduction in performance! Overall performance ratings for walls are expressed in terms of U-factor, with a lower number meaning that the heat flow through the wall is less. The overall performance for this metal framed wall in the current Energy Code is U-0.14 (which means that the heat flow is more than twice as high as the U-0.062 that is required for the electric resistance space heat path).

In terms of energy savings, the wall performance requirements in ASHRAE/IESNA Standard 90.1 for Seattle are U-0.113 maximum for metal framing and U-0.089 for wood framing. Consequently, the current Energy Code requirements do not comply with ASHRAE/IESNA Standard 90.1. In addition, if the Seattle Energy Code were to require that projects have better performing walls, then there would be greater energy savings compared to ASHRAE/IESNA Standard 90.1. This would assist in achieving the goal of Resolution 30280.

Discussion: Here are pros and cons for the DCLU recommendation and an estimate of energy savings and costs.

When ASHRAE was developing the revisions to Standard 90.1, they considered a range of insulation options to improve performance. An R-19 batt installed between metal studs only provides the equivalent of R-7.1 insulation – a 63% reduction in performance! When compared to the R-11 case, the apparent increase of R-8 (going from R-11 to R-19), really only amounts to an increase in R-1.6 (going from R-5.5 to R-7.1). Whereas continuous insulation added over the metal framing provides the full insulating R-value. Consequently, it is more effective to add continuous insulation over the metal studs to reduce the thermal bridging. The ASHRAE analysis found R-13 cavity insulation plus R-3.8 continuous insulation over the metal framing to be the next step for improving wall performance. For other large cities with high-rise construction, ASHRAE/IESNA Standard 90.1-1999 requires R-13 cavity insulation plus R-3.8 continuous insulation. This wall has a performance value of U-0.084.

Pro: Takes up less floor space compared to CCAB Option 2. Should allow reduction in costs for space heating equipment capacity. Would provide increased energy savings.

Con: May require changes in some standard details (though this assembly is used in Seattle). Results in less flexibility for trade off calculations.

Cost estimate: Consultant estimate of the cost to improve the fenestration, roof, wall, and floor insulation is $0.07 per square foot of floor area for a building that has a fenestration area that is 30% of the gross wall area and that has a ratio of wall area to floor area of 0.42.

Energy savings estimate: Savings estimated across all building types by consultant analysis is 0.5 kWh/ft^2•yr ($0.035/ft^2•yr).

KEY ISSUE #3:
SECTION 1302 SPACE HEAT TYPE

Issue: Should the "other space heat type" building envelope requirements should apply to buildings that have space heating systems that are VAV (variable air volume) with terminal electric resistance heating elements?

Background: For both residential and nonresidential occupancies, the current Energy Code has separate building envelope requirements that vary by space heat type. There are two categories: "electric resistance" and "other". The requirements for electric resistance space heat are more stringent. The residential (Group R occupancy) definition for electric resistance space heat in Section 502.2.2 includes all systems with electric resistance "as either the primary or secondary heating system" other than heat pumps. However, the nonresidential (other than Group R occupancy) definition, in addition to excluding heat pumps, also excludes "terminal electric resistance heating in variable air volume distribution systems". Consequently, VAV systems are allowed to comply with the less stringent building envelope requirements even though they have electric resistance space heat.

In terms of energy savings, the building envelope requirements in ASHRAE/IESNA Standard 90.1 do not vary by space heating type. Consequently, if the Seattle Energy Code were to require that more projects comply with the building envelope requirements for electric resistance space heat, then there would be greater energy savings compared to ASHRAE/IESNA Standard 90.1. This would assist in achieving the goal of Resolution 30280.

Discussion: Here are pros and cons for the DCLU recommendation and an estimate of energy savings and costs.

This recommendation would continue to allow VAV systems with terminal electric resistance space heat to comply with the building envelope requirements for the "other" space heat type, which are less stringent than the building envelope requirements for electric resistance space heat.

Pro: Does not alter current practice for mechanical system design. Understood by designers, developers, contractors, DCLU staff.

Con: Does not provide energy savings (with exception of CCAB link discussed below) and does not reduce Seattle City Light's peak electrical demand in the winter time.

Energy savings estimate: No energy savings.

Cost estimate: No change.

If this system was switched to the "electric resistance space heat type", the most cost-effective choice is probably the better envelope until glazing areas become large. Then the choice is to make a more substantial investment in a better envelope or to switch to another heating system type.

The change to a better building envelope system, would require a better fenestration system and more insulation. However, the prescriptive options for electric resistance space heat are limited to fenestration areas that do not exceed 30% of the gross wall area. An assessment of the North American Commercial Glazing Market (published in the April 2001 issue of Glass Magazine) indicates that the average fenestration for all buildings in the commercial glazing market is 26% of the wall area. (The Seattle sample found 29%.) However, the average fenestration area varies by building type (Seattle sample values in parentheses): 41% (37%) for office and bank, 34% (18%) for stores, 26% for

hospital/healthcare, 26% for hotel/motel/dormitory, 25% (19%) for educational, 24% (21%) for public/government, 18% for amusement/recreational, 18% for religious, 12% for warehouse, and 20% for miscellaneous. Consequently, this limitation would affect some building types more than others. For projects with fenestration areas that exceed 30% of the gross wall area, Energy Code compliance would need to be demonstrated using Target UA or systems analysis.

Cost estimate: Consultant estimate of the cost to improve the fenestration, roof and wall, and floor insulation is $0.40 per square foot of floor area for a building that has a fenestration area that is 30% of the gross wall area and that has a ratio of wall area to floor area of 0.42. (This estimate uses the wall insulation proposal in CCAB Option 2.).

Energy savings estimate: Savings estimates range from 0.3-0.9 kWh/ft^2•yr ($0.035/$ft^2$•yr).

Simple payback: 11 years.

For the change to the mechanical system, the assumption is that this option would require that a boiler be added and piping be provided to each of the terminal units so that heating could be provided by water heated by a fuel other than electricity.

Cost estimate: Consultant estimate of costs is $1.05/square foot of floor area for piping, boiler, and wiring costs for a building that has a heating density of 7 Btu/ft^2.

Energy savings estimate: Savings estimates were 0.83 kWh/ft^2•yr electricity reductions ($0.058/$ft^2$•yr) plus electrical demand reductions ($0.01/$ft^2$•yr), while gas consumption increased ($0.026/$ft^2$•yr). Net operating savings are $0.042/$ft^2$.

Simple payback: 25 years.

2001 SEATTLE ENERGY CODE:
SECTION-BY-SECTION DISCUSSION OF PROPOSED CHANGES

The proposed amendments fall into five categories:

- review and fine-tuning of the existing 1997 Energy Code including Seattle amendments,
- other Washington State Energy Code proposals,
- ASHRAE/IESNA Standard 90.1-1999 and addenda,
- results of Seattle City Light funded research on the energy-efficiency of recently constructed Seattle buildings, and
- ideas for achieving the Resolution 30280 energy savings from public review meetings earlier this year.

As is the case with the current Seattle Energy Code, there are **NO** proposed Seattle residential amendments to the Washington State Energy Code (though the Washington State Building Code Council did adopt residential amendments that are in the 2000 WSEC). All of the Seattle amendments are to the nonresidential portions (Chapters 11-15, RS-29, and applicable material in Chapter 10).

All of the amendments are summarized below in section number order and include:

- **Section number and title.**
- *Discussion:* This contains a summary of the issues and the source of the language if it has been taken from another document, such as ASHRAE/IESNA Standard 90.1-1999. (Standard 90.1 is cited in the 1992 National Energy Policy Act as the basis for Energy Codes in all 50 states. Previous versions of the Seattle Energy Code have drawn substantially from this document and its predecessors.) Carryover of existing 1997 Seattle amendments was addressed in separate ordinance 120378 for the 2000 Seattle Energy Code and is indicated by "Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code."

Table 10-5B Default U-Factors for Concrete and Masonry Walls.

Discussion: For other than Group R occupancy, provide revised values
(a) to correspond with ASHRAE/IESNA Standard 90.1-1999, Section A3.1 and Tables A-5 to A-8.
(b) to expand options to assist with prescriptive compliance for revisions to Table 13-1.
(Note that this table was formerly Table 20-5B, but was renumbered when Chapters 10 and 20 were combined in the 2000 Washington State Energy Code.)

Table 10-6 Other than Group R Occupancy: Default U-Factors for Vertical Glazing, Overhead Glazing and Opaque Doors.

Discussion: (1) Additional values for vertical glazing incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.
(2) Add values for sloped glazing to correspond with revisions to Table 13-1 to assist with prescriptive compliance.
(Note that this table was formerly Table 20-6, but was renumbered when Chapters 10 and 20 were combined in the 2000 Washington State Energy Code.)

1132.2 Building Mechanical Systems.

Discussion: Revise requirement with the goal of having all systems completely comply with the economizer requirements in 1433, or one of the exceptions, over time. Two options are provided: one is a permit-by-permit option, the other is for a long-term plan. Exceptions are provided for low ceiling heights and other instances where ductwork is impractical.

1132.3 Lighting and Motors.

Discussion: Revise requirement with the goal of having all systems completely comply with the lighting requirements over time.
(1) Require change of use per Table 15-1 to comply with lighting W/sf.
(2) Apply 60% threshold on a space-by-space basis.

1133 Change of Occupancy or Use.

Discussion: Clarify requirements for change of use from semi-heated to heated space for spaces constructed prior to 1980.

1144 Violations and Penalties.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1150 Conflicts With Other Codes.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1161 Severability.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1162 Liability.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1301 Scope.

Discussion: (1) Editorial correction
(2) Provide reduced requirements for parking lot attendant booths.

1310.2 Semi-Heated Spaces.

Discussion: (1) Provide increased requirements for roof insulation, and add minimum requirements for wall and floor insulation, and for fenestration U-factor and area.
(2) Require compliance with Section 1320 or 1330 for semi-heated spaces with electric resistance space heat.

1311.6 Radiant Floors.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1312.2 Solar Heat Gain Coefficient and Shading Coefficient.

Discussion: Allow SHGC (solar heat gain coefficient) for the center of the glass alone as an alternate to NFRC-certified SHGC for the overall fenestration assembly (including the frame), provided the center-of-glass SHGC is determined using acceptable base data. Add note indicating the differences between center-of-glass SHGC and overall fenestration assembly SHGC.

1322 Opaque Envelope.

Discussion: (1) Clarify that area-weighted averaging is not allowed for R-values and what the acceptable procedure is for U-factor calculations.
(2) Add exception with pre-calculated trade-off for edges of intermediate floor slabs which are uninsulated or that do not comply with the wall insulation requirements.
(3) Add exception with pre-calculated trade-off for roofs with tapered insulation that do not comply throughout with the minimum roof insulation requirements.

1323 Glazing.

Discussion: (1) Street level transparency requirements in the Seattle Land Use Code incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.
(2) Specify a MINIMUM visible transmittance requirement so that the glazing complying with Exception 1 has the transparency required by the Seattle Land Use Code. (Section 23.47.050 of the Seattle Land Use Code defines transparent as “clear or lightly tinted”.)
(3) Require a low-e coating or equivalent for all glazing. Companion change to Table 13-1.
(4) Provide exceptions to the solar heat gain coefficient requirement (i) for glazing inside buildings in walls separating conditioned space from semi-heated or unconditioned space (ii) with less stringent requirements for north-oriented glazing consistent with ASHRAE/IESNA Standard 90.1-1999 and (iii) with credit for shading by permanent projections that will last as long as the building itself consistent with ASHRAE/IESNA Standard 90.1-1999.

1331 General.

Discussion: Delete exception which references the use of the 1989 version of the ENVSTD program for consistency with changes to Table 13-1. Companion change to Table 13-1. However, also note that a Seattle version is proposed to be developed.

1333 UA Calculations.

Discussion: Clarify how to calculate U-factors for roofs with tapered roof insulation. Companion change to Section 1311.2.

Table 13-1 Building Envelope Requirements.

Discussion: (1) Revise prescriptive glazing paths to require better wall insulation.
(2) Revise "other space heat" prescriptive glazing paths to require better glazing comparable to ASHRAE/IESNA Standard 90.1-1999 and Addendum aj.
- For low-glazing and mid-glazing percentages, incorporate a requirement for low-e coatings (U-0.55 can be achieved by double-glazing with a low-e coating; for products without NFRC ratings, Table 10-6 has defaults that allow U-0.55 to be achieved by products that have, (i) double-glazing with a good low-e coating in a metal frame, (ii) double-glazing with any low-e coating and argon gas fill in a metal frame, and (iii) double-glazing with any low-e coating for products with a metal frame having a thermal break or a wood or vinyl frame).
- For large glazing percentages, require a better U-factor (U-0.45 can be achieved by double-glazing with a good low-e coating in a thermally improved frame; for products without NFRC ratings, Table 10-6 has defaults that allow U-0.45 to be achieved by products with wood or vinyl frames, or with the addition of argon to glazing installed in metal frames having a thermal break).
- For all glazing percentages, require a better solar heat gain coefficient (SHGC-0.40 can be achieved by double-glazing with a good low-e coating and green glass which has a high daylight transmittance).
- For mass walls, calculated using ENVSTD and having no higher total load than the 40% glazing metal frame path (which has an overall ENVSTD value for both heating and cooling that is 88% of the 2000 WSEC).
(3) Revise "electric resistance space heat" prescriptive glazing paths to require better SHGC and same relative stringency to "other space heat" as in the 2000 WSEC for metal frame walls,
- For metal frame walls, calculated using ENVSTD and having no higher total load than 88% of the 20% glazing metal frame path in the 2000 WSEC.
- For mass walls, calculated using ENVSTD and having no higher total load than the 20% glazing metal frame path in the 2001 SEC.
- Also, add a 30% glazing path for electric resistance space heat.
(4) Revise overhead glazing U-factor to correspond with current products.
(5) Revise footnote 1 to provide more consistency in code implementation. Do not give credit for insulation far below grade where there is little benefit.
(6) Add footnote to incorporate WSBCC Interpretation 94-32 with definition of roof types.
(7) Modify existing Seattle footnote 6 to provide equivalent energy savings to 40% glazing metal frame path in Table 13-1.

1401 Scope.

Discussion: Provide specific requirements for certain systems so as to achieve consistency in application of the code. Companion change to Section 1433.

1402 Mechanical Ventilation.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1411.1 General.

Discussion: (1) Minimize energy waste from standby losses for larger furnaces. Language is from ASHRAE/IESNA Standard 90.1-1999, Section 6.2.1.
(2) Require multiple stages for furnaces.
(3) Provide sizing ratios for cooling towers with air and water economizers.
(4) Prohibit use of single-pass systems for water conservation purposes.
(Note that there are companion changes to revise equipment efficiency Tables 14-1 to 14-3. Tables are located after Section 1452.)

1411.2 Rating Conditions.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1411.4 Packaged Electric Heating and Cooling Equipment.

Discussion: Clarify that heat pump requirements apply to both packaged and split systems.

1411.5 Heating Systems in Unenclosed Spaces.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1412.2 Deadband Controls.

Discussion: Do not allow deadband control to be traded off.

1412.4 Setback and Shut-Off.

Discussion: Add requirements for retention of programming and manual override, and allow exception for occupancy sensors and manual timers per ASHRAE/IESNA Standard 90.1-1999, Section 6.2.3.2.1.

1412.4.1 Dampers.

Discussion: (1) Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.
(2) Add requirements for damper air leakage from Addendum ad-4 to ASHRAE/IESNA Standard 90.1-1999. The text accompanying that addendum refers to the 10 cfm/ft^2 damper leakage rate as "middle leakage" and cites a Ruskin CD-36 as a damper that would qualify, and refers to the 20 cfm/ft^2 damper leakage rate as "high leakage" and cites a Ruskin CD-35 with blade and jamb seals and BD2 backdraft dampers as a damper that would qualify. To obtain a copy of the AMCA (Air Movement and Control Association) 500 standard and for a listing of products with certified ratings, see http://www.amca.org.

1412.6 Combustion Heating Equipment Controls.

Discussion: (1) Delete existing Seattle amendment for larger equipment sized correctly.
(2) Modify exemption for boilers.

1412.8 Enclosed Parking Garage Ventilation.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code, but require both controls for larger systems and either control for smaller systems.

1413 Air and Water Economizers.

Discussion: (1) Clarify that economizer control requirements apply to both air and water systems per ASHRAE/IESNA Standard 90.1-1999, Section 6.3.1.2.
(2) Clarify the requirement for integrated economizer control and modify the exception per ASHRAE/IESNA Standard 90.1-1999, Section 6.3.1.3.
(3) Add limit on heating system impact from ASHRAE/IESNA Standard 90.1-1999, Section 6.3.1.4. Per the 90.1 Users Manual, the following system types would not comply with this requirement: single-fan dual duct systems and some multizone systems (Figure 6-R, pages 6-53 to 6-54), and some water economizer systems (Figure 6-O, page 6-50, and Example 6-OO, page 6-53). Add informative note from the 90.1 Users Manual.

1414.1 Sealing.

Discussion: (1) Require better sealing for ductwork.
(2) Provide greater consistency between residential and nonresidential specifications for sealing methods.
(3) Add note from ASHRAE/IESNA Standard 90.1-1999, Table 6.2.4.3B to clarify categories.

1416 Completion Requirements (includes commissioning).

Discussion: The 2000 Washington State Energy Code now includes the completion and commissioning requirements from the 1997 Seattle Energy Code. The following proposed revisions are intended to make these requirements work better by:
(a) establishing minimum commissioning requirements for all mechanical systems, and
(b) describing acceptable commissioning criteria.

1421 System Type.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1421.1 System Sizing Limits.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code, but change limits to 16 and 25 Btu per square foot to reflect changes in Chapter 13 and Section 1431.

1423 Economizers.

Discussion: Structure the code requirements so that more equipment has full economizer capability (other than small units in Group R occupancy). Companion change to Section 1433.

1431.2 System Sizing Limits.

Discussion: (1) Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code, but revise sizing limit to 125%,
(2) Require multi-stage capability for loads over 300 tons.
(3) Establish separate requirements systems with heat recovery (Exception 4).

1432.2.2 Hydronic Systems.

Discussion: (1) Application to mechanical refrigeration incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.
(2) Threshold revised to 300,000 Btu/h per ASHRAE/IESNA Standard 90.1-1999, Section 6.3.4.3.
(3) Add requirements for valves per ASHRAE/IESNA Standard 90.1-1999, Section 6.3.2.2.3.

1433 Economizers.

Discussion: (1) Require economizer for most equipment and systems unless they comply with one of the exceptions. Companion change to Section 1423.
(2) Provide a simpler compliance path in Exception 3 for waterside economizer systems.

1435 Simultaneous Heating and Cooling.

Discussion: Reference to Seattle Mechanical Code incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1436 Heat Recovery.

Discussion: (1) Laboratory fume hood label incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.
(2) Add provision for steam condensate recovery for energy and water conservation.
(3) Add provision for condenser heat recovery per ASHRAE/IESNA Standard 90.1-1999, Section 6.3.6.2.

1437 Electric Motor Efficiency.

Discussion: (1) Require that motors in HVAC equipment comply with minimum efficiency requirements.
(2) Add efficiency requirements for small motors in terminal units. To obtain a copy of the NEMA MG-1 standard, see http://www.nema.org/standards.
(Note that there are companion changes to revise motor efficiency Table 14-4. Tables are located after Section 1452.)

1438 Variable Flow Systems and System Criteria.

Discussion: Incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.

1440 Service Water Heating.

Discussion: (1) Add cross-reference to equipment efficiency requirements in Tables 14-1A through 14-1M.
(2) Establish minimum efficiency requirements for commercial clothes washers for energy conservation and water conservation purposes.

1452 Pool Water Heaters.

Discussion: (1) No changes (retain existing Seattle amendment), but eliminate allowance for electric resistance heat for pools under 2000 gallons.
(2) Add minimum efficiency for heat pump pool heaters consistent with proposed Addendum ad-14 to ASHRAE/IESNA Standard 90.1-1999.
(3) Add cross-reference to equipment efficiency requirements in Tables 14-1 to 14-3.

Tables 14-1 to 14-3 HVAC Equipment Efficiency.

Discussion: Replace equipment efficiencies in Tables 14-1 to 14-3 with new Tables 14-1A through 14-1M based on 29 October 2001 values in ASHRAE/IESNA Standard 90.1-1999 (these values include Addendum j to ASHRAE/IESNA Standard 90.1-1999 to address ARI Standard 550/590-1998). Leave blank table numbers to correspond with the Standard 90.1 numbering system.

Table 14-4 Motor Efficiency.

Discussion: Adopt the CEE (Consortium for Energy Efficiency) specifications for energy efficient motors. For additional information, see http://www.ceeformt.org/ind/mot-sys/mot-sy-main.php3.

1512 Exempt Lighting.

Discussion: (1) Clarify application of the code. Incorporate WSBCC Interpretations 94-22 and 96-07.
(2) Shift from exempt spaces to exempt lighting. Language for most modifications is from ASHRAE/IESNA Standard 90.1-1999, Section 9.3.1.

1513.1 Local Control and Accessibility.

Discussion: Companion change to Section 1513.6.1.

1513.3 Daylight Zone Controls.

Discussion: (1) Require automatic controls for all daylighted spaces.
(2) Provide graphics that clarify daylight zone area.

1513.5 Automatic Shut-off Controls, Exterior.

Discussion: (1) Require exterior lighting, including signs, to be capable of being turned off during daylight hours.
(2) Provide better control for exterior lighting.

1513.6 Automatic Shut-Off Controls, Interior.

Discussion: (1) Change application to <u>all</u> buildings over 5,000 ft^2 for consistency with IESNA Standard 90.1-1999, Section 9.2.1.1.
(2) Require occupancy sensors for small offices, meeting and conference rooms, and school classrooms.

1513.6.1 Occupancy Sensors.

Discussion: Require manual switch so that occupants have the ability to turn off part or all of the lights when not needed to avoid unnecessary wasting of energy. Having a manual switch serves two purposes:

(a) The occupant can switch off the light when they ENTER a space (after it has been automatically turned on by the sensor) if the light is not needed, such as in a perimeter daylight zone.
(b) The occupant can switch off the light when they LEAVE a space so the lighting energy is not wasted for 30 minutes each time they leave while waiting for the occupancy sensor to automatically turn off the lights.

1521 Prescriptive Interior Lighting Requirements.

Discussion: The intent of the prescriptive lighting option was to provide a mechanism to transform the market for lamps, while still achieving installed lighting wattages comparable to the Lighting Power Allowance option in Section 1530. When this option was first adopted, T-12 lamps were the predominant lamp. Initially, the goal was to shift the market to T-8 lamps and to two-lamp fixtures. Now that this has taken place, and the office Lighting Power Allowance is proposed to be reduced, the original intent is maintained by providing support for electronic dimming ballasts with photocell control for daylighting and lumen maintenance. Companion change to Table 15-1. Other options considered were to limit the prescriptive option to single-lamp fixtures or to not allow the use of T-8 lamps.

1530 Lighting Power Allowance Option.

Discussion: (1) Definition of low voltage track incorporated into separate ordinance to carry over previous Seattle amendments to the 1997 Washington State Energy Code.
(2) Revise default assumptions for track lighting to reflect current practice.

1532 Exterior Lighting Power Allowance.

Discussion: Ensure that exterior lighting is used in the area allotted for it.

Table 15-1 Unit Lighting Power Allowance (LPA).

Discussion: (1) Revise lighting power allowances to reflect current practice. Research on buildings that were constructed and occupied in Seattle during the last three years found lower installed lighting wattages, but with little additional task lighting. Part of this is in response to a need to minimize glare on computer monitors.
(2) Provide separate, higher lighting power allowance for medical office as a companion change to revisions to 1512.1 item 1 and 1512.2 item 9.

1540 Transformers.

Discussion: Provide increased efficiency requirements for internal building transformers. For additional information including a copy of the NEMA TP 1 standard, see http://www.ceeformt.org/ind/trnsfm/trnsfm-main.php3.

RS-29, Section 3.6.5, Parking Garage Ventilation.

Discussion: Clarify the baseline for RS-29 analysis.